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Herbage Production and Quality of Shrub Indigofera Treated by Different Concentration of Foliar Fertilizer

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ABSTRACT

A field experiment on fodder legume *Indigofera* sp. was conducted to investigate the effects of foliar fertilizer concentration on forage yield and quality, and to identify optimum concentrations among the fertilizer treatments on herbage yield, chemical composition (CP, NDF, ADF, minerals), and *in vitro* dry matter (IVDMD) as wll as organic matter (IVOMD) digestibility in goat's rumen. Randomized block design was used for the six concentration of fertilizer treatments; control, 10, 20, 30, 40, and 50 g/10 l with 3 replicates. Leaves were sprayed with foliar fertilizer at 30, 34, 38, and 42 days after harvest. Samples were collected at 2 harvest times with 60 days cutting interval. Application of the foliar fertilizer up to 30 g/10 l significantly increased herbage DM yield, twig numbers, tannin, saponin, Ca and P content, as well as herbage digestibility (IVDMD and IVOMD). The lower and higher concentration of foliar fertilizer resulted in lower value of those parameters, but NDF and ADF contents had the opposite patterns. The optimum level of foliar fertilizer that resulted the highest herbage yield and quality was 30 g/10 l, and the highest *in vitro* digestibility and Ca concentration was 20 g/10 l.

Key words: Indigofera, foliar fertilizer, tannin, saponin, digestibility

INTRODUCTION

Ruminant productivity is largely determined by the quality of forage. Forage in Indonesia, particularly grasses contain lower crude protein (average 7%-11%) and TDN (50%-60%) than those nutrients required by animal. This means, farmers have to add other sources of nutritious feed in ration in order to meet nutritional needs and sustain their animal performance. Appropriate feeding management by introducing fodder legume such as Indigofera in ruminant ration may improve nutrient intake and animal production. Inclusion of Indigofera in ruminant ration needs to be considered due to its high nutritional value. Herbage of Indigofera contained high crude protein (27.60%), produced leaf of 4,096 kg DM /ha/harvest at 68 days of cutting time, *in vitro* DM digestibility 67%-81% (Abdullah & Suharlina, 2010). Inclution of Indigofera up to 45% in rations of the local cross bred goat of Boor-Kacang increased significantly their average daily gain (Tarigan *et al*., 2009). Indigofera tolerates to drought, light floods and moderate salinity (Hassen *et al*., 2008).

Use of the legumes as forages in Indonesia is still limited due to low herbage yield, no sustainable herbage production system and lack of farmer's knowledge in legumes cultivation. Herbage production system with tea plantation has been initiated at Bogor Agricultural University's research station. The crucial aspect of this herbage production model was to keep nutrient availability for individual forage plants during growth period, due to intensive nutrient losses at forage harvest. Increase herbage production and quality of Indigofera becomes priority in such production management. Forage plants require available nutrients to sustain production and quality of herbage during establishment of vegetative periods. Application of foliar fertilizer has been applied effectively to increase leaf production (El-sheikh *et al.* 2007; Hassan *et al.* 2010). Several findings revealed positive effect of foliar fertilizer on growth, yield components and protein content of legumes (Henselová & Slováková, 2010), as well as total chlorophyll (a+b), carotenoids and total carbohydrates and the mineral (N, P, K, Zn and Cu) contents of leaves (El-Naggar, 2009).

In this study, application of foliar fertilizer was conducted in order: (1) to increase herbage yield and its quality, and provide rapidly available nutrition for the plants; (2) to recognize the effect of foliar fertilizer on herbage DM yield, minerals content, cell wall fraction content, *in vitro* digestibility, total tannin and saponin content in leaf; and (3) to investigate a proper concentra-

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tion of foliar fertilizer applied that produced maximum of Indigofera's herbage yield and quality.

MATERIALS AND METHODS

Time and Location

The field experiment was conducted from April 2009 to September 2010 at the University Farm, Bogor Agricultural University, Indonesia (6°31' SL and 106°44' WL at altitude 201 m above sea level). Average monthly rainfall, air temperature and relative humidity during experimental period is shown in Figure 1. The average monthly- rainfall in 2009 was 291 mm (33–416 mm), average air temperature 26.2 °C (25.8–26.6 °C) and average relative humidity 80% (75%–88%), meanwhile during January–September 2010 average monthly-rainfall, average air temperature and average relative humidity were 350 mm (252–601 mm), 25.9 °C (25.0–27.1 °C) and 85% (77%–88%), respectively.

The soil used in the experimen was latosols indicating low water extractable soil pH (4.80-5.20), low N (0.15%-0.22%), very low available P (3.6%-4.6%; Bray 1), organic C (1.67%-1.88%; Walkey & Black), low mineral exchangeable- Ca (3.25-4.32 me/100g ;NH_4O.Ac pH 7), K (0.12-0.17 me/100g; NH_4O.Ac pH 7), Mg (0.32-0.48 me/100g NH_4O.Ac pH 7), moderate cation exchange capacity (16.91-17.24 me/100g; NH_4O.Ac pH 7). The soil consisted of sand 7.68%-8.30%, silt 25.69%-25.97% and clay 66.02%-68.21%.

Chemical analysis and digestibility determination were carried out at Laboratory of Feed Technology and Industry and Laboratory of Dairy Nutrition, Department of Nutrition and Feed Technology, Faculty of Animal Science, Bogor Agricultural University.

Plants Materials

Indigofera plants used in this study were 6 months-old that have been established in the field, with planting dimension 1.5 x 1.0 m. The individual shoot canopy diameter was about 78-95 cm, so intraspecies interaction within plots might occur. The plots were made with dimension 6 x 4 m, enabling population density of 25 individuals of Indigofera plants each plot. The plants were then pruned forming tea plant model with vertical height about 1.0 m a month before first foliar fertilizer application. Irrigation was applied when precipitation did not fall within 3-4 days.

Foliar Fertilizer Application

The foliar fertilizer in form of powder composed of N (NH_4NO_3), P (H_2PO_4), Mg ($MgSO_4.7H_2O$), K (K_2SO_4), Ca ($CaCl_2$), Fe ($FeSO_4$), Zn ($ZnSO_4.7H_2O$), Cu ($CuSO_4.5H_2O$), Mo ($(NH_4)_6Mo_7O_{24}.4H_2O$), B (H_3BO_3). Doses of foliar fertilizer for each 10 L solvent were adjusted to treatment level of: 10, 20, 30, 40 and 50 g. The foliar solvent was made from the mixture of bovine urine (1.25L) and nutrient solution (8.75L) that enable additional nutrients and natural hormones originated from urine in the foliar fertilizer. The mixed soluton of foliar fertilizer contained nutrients: 20%-22% N(N total), 15%-16% P (P_2O_5), 15%-16% K, 1.5% Mg, 1% Ca, 1% Fe, 1.42% Zn, 0.53% Cu, 0.88% Mo, 0.53% B and indole acetic acid (IAA) 0.025% and giberelic acid (GA). Foliar fertilizer was sprayed on leaf surfaces 4 times within single growing period; 30, 34, 38, and 42 days after harvest, and afterward the foliar fertilizer was applied regularly with the same method.

Herbage Harvest and Sample Preparation

Forage was harvested with 60 days cutting interval. Samples were collected from 2 harvest times. Samples used for chemical analysis and biological-nutritive value determination represented composite of herbage from 2 harvests. The herbage consisting of leaves (including petioles) and edible twigs were harvested from individual plants, and the plant stands were remained one meter height. Fresh herbage was weighed and about 2 kg of sample was air dried and then dried at 65 °C. The

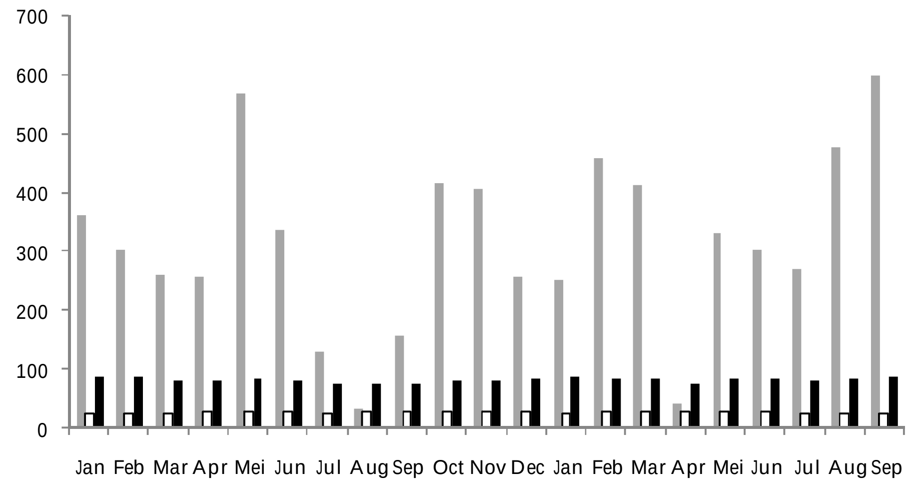

Figure 1. Average monthly rainfall, air temperature, and relative humidity at the location of experiment. ■ = rainfall (mm); □= temperature (°C); ■= RH (%).

dried samples were then ground to pass through a 1 mm sieve and representative subsamples were stored and prepared for laboratory analysis.

Chemical Composition Analysis and Nutritive Value Evaluation

Water content was determined by drying sample at 105 °C (AOAC, 2005) for 3 h. Nitrogen content was analyzed with Kjeldahl method. Preparation for mineral content analysis was conducted by using wet ashing method standard. Total P was determined colorimetrically with an auto analyzer, and other minerals were measured by atomic absorption spectrophotometer. Neutral detergent fiber (NDF) and acid detergent fiber (ADF) analysis were determined according to Van Soest (1964). *In vitro* dry matter digestibility (IVDMD) and organic matter digestibility (IVOMD) analysis were conducted using goat's rumen fluid accoding to the method of Tilley & Terry (1963). Ash contents were determined by combustion (550 °C for 2 h) and these data used to correct herbage sample weight for potential contamination with soil. Tannin content was determined according to the method of Barman *et al*. (2010) and Makkar *et al*. (1993). Saponin analysis was conducted based on the method of Hiai *et al*. (1976).

Experimental Design

Treatments were levels of foliar fertilizer concentration: 10 g/10 l, 20g/10 l, 30g/10 l, 40g/10 l and 50g/10 l) with 3 replications. The treatments were allocated in a block-randomized design. Data were analyzed statitistically with analysis of variance and further analysis was conducted by using orthogonal polynomial (Steel & Torrie, 1995). The significant model indicating the relationship between foliar fertlizer concentrations and the parameters measured were evaluated.

RESULTS AND DISCUSSION

Herbage Production

Application of foliar fertilizer on Indigofera increased (P<0.01) herbage yield (Figure 2). Herbage yield at the first and second harvest ranged from 4.1 ton DM/ha to 6.8 ton DM/ha and 6.0 ton DM/ha to 7.9 ton DM/ha, respectively. The variation coefficient of the herbage yield was good ranging from 7.89% to 15.94%. Application of foliar fertilizer at doses of 10 g/10 l to 50 g/10 l increased (P<0.01) 12.69% to 65.85% of herbage yield at the first harvest. Application of 30 g/10 l resulted in the highest level of herbage yield (6.8 ton DM/ha). Increase concentration of foliar fertilizer up to 50 g/10 l significantly reduced herbage production. The herbage production curve at the first harvest follows quadratic model of $y= -0.002x^2 + 0.141x + 3.86$ (R^2= 0.810). Application of foliar fertilizer provides readily available nutrients (N, P, K, Mg, and other macro and micro elements) in the leaves, which function very important in photosynthesis and development of vegetative fraction.

Herbage yield in the second harvest was 30% higher (P<0.01) than that of the first harvest. Foliar fertilization produced more herbage yield of 14.57% to 31.50% than that of control. Spraying 30 g/10 l of foliar fertilizer resulted in maximum herbage yield of 7.9 t DM/ha, which denoted optimum level of fertilization. A quadratic curve as a response of herbage yield to the foliar fertilzation in the second harvest was similar to that in the first harvest with the equation: y= -0.001x2 + 0.100x + 6.012 (R^2= 0.858) (Figure 2). Increase amount of foliar fertilizer up to 40 g/10 l and 50 g/10 l reduced significantly herbage production about 0.8 t DM/ha. These foliar concentrations seemed to be excessive levels for Indigofera in this study. The same result was reported that foliar fertilization at certain levels (up to 0.6%, optimum level) tended to increase growth of branch and stem length of *Dianthus caryophyllus* but then reduced by extent the concentration (El-Naggar, 2009).

The reduction of herbage yield as a response to excessive concentration of fertilizer seemed to associate with the reduction of twig numbers. The mathematical equation for twig number were $y= -0.042x^2 + 3.067x + 77.28$ (R^2= 0.782). It indicated that increasing doses of foliar fertilizer (after application of the optimal dose) decreased the number of twig. Twig numbers was limited by growing space at the top of the plants, when dose of fertilizer exceeded. Growing space was limited due to the rapid twig development that caused shading among the leaves, and in turn caused inhibition of sunlight penetration for photosynthesis process and reduced herbage yield. Twig weight decreased up to 14.9% with increasing doses of foliar fertilizer. Twigs accumulate fastly the 'older' tissues during plant structure development, when the plants obatained low or excessive concentration of fertilizer. A dynamic accumulation of dry matter occurs when the twig of plants get older (Abdullah, 2009).

Crude Protein, NDF and ADF Content

Crude protein (CP) is an important parameter indicating forage quality. The content of CP of Indigofera's

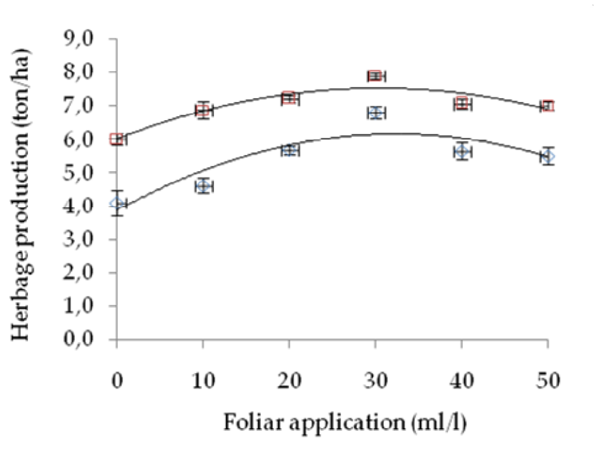

Figure 2. Herbage yield of Indigofera resulted from the 1st (◊) and 2nd (□) cutting as response to different concentration of applied foliar fertilizer.

herbage ranged between 28.76%-29.83% (deviation standard ranged 0.60%–1.73%), and it was not significantly affected by foliar fertilization (Table 1). Unchanged CP content of legumes due to fertilization might be associated with the ability of legumes to supply their N requirement through N_2 fixation with *Rhizobium*. Indigofera develops very intensive nodulation when the fertilizer was absence.

The fiber fraction or cell wall contained in forages are the main concern in ruminant nutrition, since most of ruminant diets consist of large amounts of forage, and the fiber fraction determines both feed intake and animal performance. The NDF and ADF content of forage were significantly (P<0.01) affected by foliar fertilizer application (Table 1). NDF content ranged between 38.30%-50.05%. This number was higher than those of *Indigofera arrecta* grown in spring (32.80%) (Hassen *et al*., 2007). This is comparable to the previous research results of NDF content in the Indigofera ranging 49.4%-59.97% (Abdullah & Suharlina, 2010).

Application of foliar fertilizer at dose up to 20 g/10 l and 30 g/10 l reduced NDF and ADF content (P<0.05) of 13.7% and 23.2%, respectively. These levels of foliar fertilizer induced the lowest NDF and ADF content in the forages. However, increasing dose of fertilizer up to 40-50 g/10 l resulted in significant increase of NDF and ADF by about 24% and 35%, respectively. The relationship between dose of foliar fertilizer and NDF and ADF content showed in a quadratic model as follows $y= 0.01x^2 – 0.341x + 43.01$ (R^2= 0.915) and $y= 0.019x^2 – 0.796x + 35.91$ (R^2= 0.941), respectively.

Application of fertilizer through the soil did not provide a consistent influence on the fraction of fibers such as NDF and ADF. A study that reported a reduction in the amount of fibers occurred in cassava (Okwu & Awurum, 2001). Decrease in NDF and ADF content at level 20-30 g/10 l fertilizer might due to the maximum absorption of fertilizer by stomata and in turn it utilized by plants for photosynthesis process. Optimum nutrient absorption, particularly nitrogen by leaves leads to develop more cell content (sugar, starches, fat, protein, NPN and pectin) that allows the plant to be more succulent and and have less cell wall components. The same results was reported that increased in N fertilizer application in turf grass caused significant reduction of NDF and ADF (Türk *et al*., 2009) and crude fiber content (Abdel-Gwad *et al*., 2008). These results are consistent with the current results at application of optimum foliar fertilizer.

Application of excessive doses of foliar fertilizer up to 40-50 g/10 l had an impact on diminished absorption due to the selectivity of the stomata in the absorption mechanism (Marschner, 1995). The nutrients are absorbed by leaf through the epidermis, guard cells, stomata, mesophyll, and vascular sheath (Marschner, 1995). Leaf cells absorb nutrients through apoplasma. Absorption by the whole leaf is lower than the level of absorption by the roots. At a high concentration of nutrients from the outside, the cuticle will limit the diffusion of the leaf surface into the contents of apoplasma leaves (Marschner, 1995). This may be a reason of increase of NDF and ADF content and reduction of minerals content due to excessive concentration of foliar fertilization.

Total Phenolic Tannin and Saponin

Tannin was traditionally considered as antinutrition compound for animals, but it is now recognized to have nutritional benefit, in particular to protect high quality dietary protein from microbe degradation in rumen. The presence of tannin in Indigofera has been considered as chemically supports its function as protein supply forages. The tannin itself may improve the use of protein contained in Indigofera's herbage. Tanin showed positive effects in reducing NPNs of the round bale silages (Schiavone *et al***.,** 2008**;** Tabacco *et al*., 2006) and improved fermentability of soya meal nitrogen in the rumen (Gonzales *et al*., 2002).

This study found that total tannins content increased (P<0.01) by increasing foliar fertilizer concentra-

Table 1. Chemical compositions and *in vitro* digestibility of Indigofera's herbage as a respons to the foliar fertilizer concentrations

Chemical composition and digestibility	Foliar fertilizer concentration (g/10L)					
	0	10	20	30	40	50
Crude protein (%)	27.68±0.75	27.76±0.23	27.79±0.36	27.68±0.80	27.76±0.66	27.83±0.68
Tannin (%)	0.08±0.01^{c}	0.36±0.05^{b}	0.38±0.05b^{c}	0.42±0.03^{b}	0.61±0.04^{a}	0.36±0.03^{b}
Saponin (%)	0.41±0.02^{c}	0.78±0.06^{b}	0.68±0.07^{b}	1.17±0.07^{a}	0.79±0.05^{b}	0.77±0.08^{b}
NDF (%)	43.56±1.25^{b}	40.58±1.70^{bc}	38.30±1.72^{b}	43.26±1.53^{b}	47.60±1.82^{a}	51.05±1.55^{a}
ADF (%)	35.24±1.25^{b}	30.12±0.75^{bc}	29.60±2.01^{c}	28.62±0.82^{c}	32.43±1.68^{b}	45.29±1.10^{a}
Ca (%)	1.16±0.02^{c}	1.34±0.08^{b}	1.78±0.06^{a}	1.49±0.05^{b}	1.42±0.04^{b}	1.32±0.06^{b}
P (%)	0.26±0.01^{b}	0.29±0.01^{a}	0.31±0.01^{a}	0.28±0.02^{ab}	0.26±0.01^{b}	0.26±0.02^{b}
K (%)	1.31±0.11	1.40±0.10	1.30±0.08	1.36±0.03	1.42±0.08	1.23±0.03
Mg (%)	0.46±0.02	0.45±0.04	0.48±0.02	0.51±0.04	0.45±0.02	0.45±0.02
IVDMD (%)	67.50±3.21^{c}	73.76±2.83^{b}	85.50±4.24^{a}	75.44±2.02^{b}	75.42±0.66^{b}	73.20±1.76^{b}
IVOMD (%)	60.32±4.82^{c}	72.06±2.81^{b}	82.65±3.16^{a}	76.98±1.43^{b}	73.45±0.74^{bc}	71.50±3.52^{b}

Note: Means in the same row with different superscript differ significantly (P<0.05). NDF= neutral detergent fiber; ADF= acid detergent fiber; IVDMD= *in vitro* dry matter digestibility; IVOMD= organic matter digestibility.

tion (Table 1). The total tannin content ranged between 0.08% to 0.61% with the average variation coefficient within treatments 16.4% (5.6%-37.5%). The highest total tannin content was investigated in the forage fertilized at dose of 40 g/10L. Application of foliar fertilizer increased total tannin content in the herbage by about 3 to 6 folds of those of control. Significant quadratic model for expressing the relationship between foliar fertilizer concentration and herbage tannin content was: $y = -0.0003x^2 + 0.0206x + 0.0946$, ($R^2 = 0.6928$). Foliar fertilizer application with dose at 30 g/10 l resulted in the highest tannin content in herbage, and increased dose of foliar fertilizer up to 50 g/10 l tended to reduce tannin content, although it was higher than that of control. The content of tannin seemed to be influenced by changes in soil nutrient availability and sub-optimal environmental conditions that lead to plant stress (Bush *et al*., 2007). Baloyi *et al*. (2007) revealed the facts that tannin and saponin content in *Stylosanthes scabra* were influenced by plant parts and agroecological condition of the area. Other study revealed the increased in tannin content in birdsfoot trefoil when the plant grown with a companion grass (Wen *et al*., 2003).

Saponin is one of amphipathic glycosides group producng the soap-like foaming when it is shaken in water. The compound is known as anti bacterial and anti protozoa in many ruminology studies. Saponin content of Indigofera forage ranged between 0.41% to 1.17% (Table 1). Foliar fertilizer application with dose at of 10-50 g/10 l caused a significant increase ($P<0.01$) in saponin content in the herbage.

Relationship between the saponin content and dose of applied fertilizer showed similarities with the pattern of tannin ($y= -0.0005x^2 + 0.0340x + 0.4182$; $R^2= 0.6343$). Saponin content increased by increasing fertilizer content up to 40 g/10L, but it tended to decrease by increasing foliar fertilizer concentration of 50 g/10 l that might indicate excessive level. Other studies revealed that certain level of P-application increased tannin and saponin content of *Centela Asiatic* (Sutardi & Gulamahdi, 2010). The change of saponin was influenced by cultivar and a biotic environment (Ruiz *et al*., 1995; Szakiel *et al*., 2010). It may associate with photosynthetic process, which induces sugar and glycoside content in plant tissue. The photosynthetic is basically driven by sun light, water, CO_2 and nutrient. The results of present sudy have clearly indicated that foliar fertilizer containing macro and micro nutrient played important role in enzymes activation and ATP in metabolic process (Marschner, 1995), which in turn affected tannin and saponin formation. Insufficient and excessive dose resulted in lower saponin level than that of optimum level of the foliar fertilizer.

Mineral Content

Calcium and phosphorus are macro minerals that are needed for growth and production of ruminants. Calcium and P content of forage were influenced ($P<0.01$) by foliar fertilizer application (Table 1). The content of Ca and P ranged from 1.16%-1.78% and 0.26%-0,31%, respectively, with coefficient of variation for both Ca and P were in average of 6.95% and 5.31%, respectively. Application of foliar fertilizer with does at 10 g/10L did not increase the content of Ca, but trhe higher dose of fertilizer up to 20, 30, and 40g/10 l increased Ca content by 53.45%, 28.45%, 22.41%, respectively. Application of 30 g/10 l produced maximum level of Ca content (1.78%). Increased dose of foliar fertilizer up to 10 g/10 l and 20 g/10 l resulted in significant ($P<0.01$) increased of P content by 11.54%-19.23%, but the higher level of foliar fertilizer (30-40 g/10 l) reduced P content ($P<0.01$) but it was not significantly different to control. Nagy *et al.* (2008) revealed increase of Ca content in plant tissue by increasing Ca concentration in foliar fertilizer, but was not significantly affected K content. Foliar fertilization at optimum level (20-30 g/10 l) led to increase mineral absorption by leaf surface (stomata), but application of excessive concentration might cause reduction or no change of plant mineral content due to an osmotic effect (Yuncai *et al*., 2008). Foliar fertilizer application did not affect K and Mg content. The content of K and Mg ranged between 1.3%-1.42% and 0.46%-0.51, respectively.

in Vitro Digestibility

Digestibility of herbage indicates the proportion of a herbage which can be digested by the animal, and has correlation to biological use of nutrient. The higher the digestibility of herbage the higher the utilization of nutrient for growth and maintenance of animals. *In vitro* dry matter digestibility (IVDMD) and *in vitro* organic matter digestibility (IVOMD) of Indigofera's herbage in goat's rumen liquids ranged between 68%-85% and 60%-83%, respectively as depicted in Table 1. The IVDMD (85%) increased ($P<0.01$) by application of foliar fertilizer up to 40 g/10 l, whereas IVOMD (83%) increased ($P<0.01$) by increase dose of foliar fertilizer up to 50 g/10 l. Application of 20 g/10 l foliar fertilizer was optimum level that resulted in maximum IVDMD and IVOMD. Increased concentration of foliar fertilizer significantly reduced dry and oragnic matter digestibility, but the values were still higher than those of control. A mathematical equation for the response of IVDMD and IVOMD to the concentration of foliar fertilizer followed quadratic equations: $y= -0.015x^2 + 0.801x + 68.71$ ($R^2 = 0.575$) for IVDMD, and $y= -0.081x^2 + 4.707x + 158.8$ ($R^2 = 0.528$) for IVOMD. These pattern of digestibility are supported the NDF and ADF patterns indicating that reduction of cell wall content were in line with the increased in IVDMD and IVOMD when the foliar fertilizer concentration was about 20-30 g/10 l. The opposite pattern with the increase in the cell wall content when the applicaton of foliar fertilizer concentration was lower (10 g/10 l) or higher (40-50 g/10 l). The studies involving Orchardgrass (Kane & Moore, 1961), N-based foliar fertilizer (Merrill *et al*., 1961) and Bahiagrass (Arthington *et al*., 2002) indicated that the digestibility, as well as dry matter and energy yields of forage were significantly increased by the use of fertilizer. Under unfavorable conditions, the negative effects of fertilizer application on the digestibility were noted. Fertilization was also found increased water-soluble fraction (portion of the carbohydrates protein, and minerals) and *in situ* effective degradability of tall fescue (Reynolds *et al*., 2010) and crude protein content, but other finding reported no significant effect of organic fertilizer on organic matter digestibility of *Pannicum maximum* (Sodeinde *et al*., 2009).

Indigofera's herbage contains relatively low NDF, ADF and crude fiber (Abdullah & Suharlina 2010), but it contained relatively high protein content (about 28%-29%). Plant tannins have both positive and negative effects on feed digestibility and animal performance, depending on both the quantity and biological activity of the tannins that are present (Schofield *et al*., 2001). Tannin had negative correlation with IVDMD (r= -0.615; P<0.05), but did not significantly correlate with IVOMD (r= -0.486 ; P>0.05).

CONCLUSION

Foliar fertilizer significantly influenced Indigofera's herbage DM yield, twig numbers, NDF, ADF, tannin, saponin, Ca and P content, and *in vitro* digestibility. Foliar fertilizer concentration of 30 g/10 l was the optimum level to obtain highest herbage yield, digestibility, and Ca content.

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